Maharshi Dayanand University
Rohtak

Ordinances, Syllabus and Courses of Reading for M.A./M.Sc. Maths. (Final) Examination

Session—~~1996-97~~ 1998-99

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ORDINANCE - 'MASTER OF SCIENCE EXAMINATION'

1. The Master of Science Examination shall be held in two parts. Part-I Examination shall be held at the end of the first year and Part-II Examination at the end of the second year.

2. The Examination in Part-I and Part-II shall be held once a year ordinarily in the month of April on such dates as may be fixed by the Vice-Chancellor.

   A supplementary examination in Part-II of M.Sc. will be held in December for those candidates who have passed all the papers of Part-I examination but have got 'reappear' or have failed or want to improve their score in paper(s) of part-II examination. However, total number of chances will not exceed as given in the Ordinance.

3. The last date for the receipt of admission form and fee without late fee as fixed by the Vice-Chancellor shall be notified to the Heads of the University Teaching Departments and the Colleges concerned.

4. A candidate's admission form and fee may be accepted after the last date on payment of Rs. 105/- up to the date notified by the University.

   No late fee shall be charged if the admission form and fee are received within three working days of grace after the last date for the receipt of the same without late fee.

5. No one shall be eligible to join the first year (Part-I) class of M.Sc. Course unless he has passed one of the following examination:-

   a) B.Sc. (Hons.) examination of this University with atleast 45% marks in the aggregate in the subject offered for the M.Sc. Course.

   b) B.Sc. (Pass) examination with atleast 50% marks in the aggregate.

   c) An examination of any other university recognised by the University as equivalent to (a) or (b) above.

   Provided that:

   i) to be eligible to join M.Sc. Course in Physics, a candidate must have passed B.Sc. Examination with Physics and Mathematics as two of the main subjects;

ii) to be eligible to join M.Sc. Chemistry, a candidate must have passed B.Sc. Examination with Chemistry as one of the main subject.

Note: A Minimum of 25% of the total seats shall be filled in by the students who have passed the B.Sc. Examination with Chemistry, Physics and Mathematics. Any seat remaining unfilled out of this quota may be offered to other eligible candidates.

iii) to be eligible to join M.Sc. course in Bio-Science, a candidate must have passed B.Sc. Examination with Botony, Zoology, Bio-Sciences and any one of the subjects viz. Chemistry, Bio-Chemistry, Micro-Biology Fisheries and Geology.

Note: The candidates will be required to opt for Animal Sciences or Plant Sciences or Environmental Biology in M.Sc. final course which will be allowed after taking into consideration the performance of the candidate in M.Sc. previous examination. However, an indication to this effect will be required to be given by the candidate at the time of his admission.

iv) conditions for admission to M.Sc. Course in Mathematics shall be same as prescribed for admission viz. M.A. Course in this subject.

v) To be eligible to join M.Sc. Course in Geology, a candidate must have passed B.Sc. Examination with atleast 50% marks in the aggregate with Geology and any of two of the subjects viz. Physics, Mathematics, Chemistry Botony, Zoology, Bio-Science and Geography;

vi) to be eligible to join M.Sc. Course in Mathematical Statistics and Operations Research a candidate must have passed B.A./B.Sc. (Pass) Examination with atleast 50% marks in the aggregate with Mathematics or Statistics as one of the subjects or have passed B.A./B.Sc. (Hons.) Examination in Mathematics or Statistics with atleast 45% marks in Mathematics/Statistics.

There shall be a Project Report in M.Sc. Mathematical Statistics (Final) and that the project report shall be evaluated by the external examiner on five point grading. The last date for submission of Project Report will be two months after the theory papers which can be extended further by two months

with the permission of the Vice-Chancellor.

Note : *A candidate who is placed under compartment in the qualifying Examination shall not be allowed to join M.Sc. Course. He/She will be eligible only after clearing the qualifying Examination.*

6.1 A candidate who has failed in one or more papers or fails to appear in the examination shall be allowed two additional subsequent chances only to pass the examination.

6.2 A candidate who fails to pass the M.Sc. examination within a period of four years of his admission to the course shall be deemed to be unfit for postgraduate studies in the subject concerned.

6.3 A person who has passed the M.Sc. (Previous) examination in the subject concerned from this University shall be eligible to join the M.Sc. final class. This is subject to Clause-6.2 above. However, the candidates who have passed atleast two theory papers out of four or five theory papers or atleast three theory papers out of six or seven theory papers of part-I examination of this University will be promoted to Part-II Class, provisionally.

7. M.Sc. Examination in Part-I/Part-II shall be open to a student who:-

a) has passed the requisite qualifying Examination or is covered under Clause-6 and

b) has his name submitted to the Controller of Examinations by the Head of the University Department/Principal of the College, he has most recently attended and produces the following certificates signed by him:-

i) of possessing good character;

ii) of having remained on the rolls of the Department/College, during the year preceding the Examination;

iii) of having attended not less than 65% of full course of lectures and tutorial separately and 75% of practicals in each part (the course to be counted upto the last day when the classes break up for the preparatory holidays).

8. A candidate whether a regular student or an ex-student shall submit his admission application to the Registrar/Controller of Examinations duly signed by the Principal of the College/Head

of the University Department he has last attended.

9. Every candidate shall be examined according to the Scheme of examination and syllabus as approved by the Academic Council from time to time.

10. The amount of Examination fee to be paid by a candidate for each part shall be as follows:-

Regular student	Ex-student
Rs. 100/-	Rs. 110/-

Note:- *Plus Rs. 20/- per practical subject.*

A candidate who re-appears in one or more theory or practical papers for the purpose of passing the examination or a candidate who appears in one or more theory papers for the purpose of improvement of score of marks/result shall pay fee as for the whole examination.

11. The medium of instructions and examination shall be English.

12.1. The minimum number of marks required to pass the examination shall be as under:-

i) 33% in each paper (written and practical) separately;

ii) 40% in dissertation/Viva-voce where prescribed;

iii) 40% in the aggregate.

12.2 A candidate who has completed the prescribed course of instructions in a College/University Teaching Department for Previous/Final examination but has not appeared in it or have appeared fails may be allowed on the recommendation of the Principal of the College/Head of University Teaching Department concerned to appear in the subsequent years in the examination paper(s) as the cases may be without attending a fresh course of instructions while re-appearing in the examination, the candidate shall be exempted from re-appearing in the paper(s) and/or practical(s) in which he has obtained atleast 40% marks.

13. As soon as possible, after the termination of the examination the Registrar/Controller of Examinations shall publish the result of the Candidates and issue Detailed Marks Card.

14. The result of candidates who have passed M.Sc. examination shall be classified into divisions, as under and the division obtained by the candidate will be stated in his degree.

a)	Those who obtain 60% or more marks	First Division
b)	Those who obtain 50% or more but less than 60% marks	Second Division
c)	All below 50%	Third Division

15.1 A candidate who has passed M.Sc. Previous examination. with atleast 55% marks may offer dissertation wherever prescribed in the Scheme of examination for the course. The subject of dissertation shall to approved by the Head of Department concerned. A candidate shall submit to the Head of the University Department an application for the approval of the topic for the dissertation alongwith a synopsis within one month of his admission to M.Sc. (Final) examination.

Provided in the case of M.Sc. (Geology) exam. there shall be a dissertation based on days field work (surface maping) in the M.Sc. Previous. The work of dissertation will be done in the M.Sc. previous and viva-voce examination of dissertation will be held at the end of M.Sc. previous alongwith practical examination. Provided further that the condition of obtaining 55% marks in M.Sc. previous examination, for offering dissertation in M.Sc. final shall not be applicable in the case of students of M.Sc. (Geology) course.

15.2 Every candidate who offers dissertation shall be required to submit three copies of his dissertation alongwith a brief abstract of the same giving an account of the Investigation research conducted and its main findings (which will not exceed 500 words). The dissertation shall be examined by one external examiner only.

15.3 The last date for receipt of the dissertation in the office of the Controller of Examinations shall be one month before the commencement of the theory examination: Provided that in exceptional cases; the Vice-Chancellor shall have the power to extend, on the recommendation of the Head of the Department the last date for receipt of the dissertation upto three months. If a candidate fails to submit the dissertation even during the extended period he will be considered to have absented in the dissertation paper and his result shall be declared accordingly.

15.4 A candidate who has submitted a dissertation as part of his examination may withdraw the same before it has been

examined but once it is examined and the candidate obtains the minimum pass marks he shall not be permitted to withdraw it or submit another dissertation in lieu thereof. The marks obtained by him for the dissertation shall be taken into account when he appears in any future examination for the purpose of passing therein or for improving score of marks/result.

16. A candidate who has already passed the Master of Science examination from this University, in a subject in which different optional papers are permitted, may appear in one or more optional paper(s) of that subject at an subsequent examination when held as a regular student only. The examination fee shall be Rs. 35/- each paper.

Such a candidate shall in order to pass, be required to obtain atleast 40% marks in each paper in theory and practical separately.

17.1 A person who has passed the M.Sc. previous examinations of this University will be allowed to appear as an ex-student in the M.Sc. previous examinations for improvement alongwith M.Sc. final examinations respectively, only once, in one or more theory paper(s) within a period of 3 years of passing M.Sc. previous examination.

A person who has passed the M.Sc. examination of this University, and desirous of improving his score of marks will be allowed to appear as an ex-student in the M.Sc. final examinations, for improvement only once in one or more theory paper(s) within a period of two years of his passing the M.Sc. examination. In all a candidate will be allowed to avail one chance within the period specified above. Improvement in practical paper is not permissible.

The result of such a candidate shall be declared only if he improves his score of marks, by taking into account the marks obtained by him in the paper(s) in which he re-appeared and the marks obtained by him earlier in the remaining paper(s). The fact that the candidate has improved the division shall be mentioned in the Detail Marks Cards. If a candidate opts to appear in both previous and final examinations for the purpose of improvement but finds that he has improved the score of marks obtained by him in the previous examination, he may not appear in the final examination as the case may be and

inform the Controller of Examinations for the declaration of his result.

Provided further that the candidate will take the examination according to the syllabus in force for the regular students for that examination. Provided that the syllabus for the candidates for the special examination to be held in September/October shall be the same as was in force for the regular student in the last annual examination.

18. Notwithstanding the integrated nature of this course which is spread over more than one academic year, the Ordinance in force at the time a student joins the course shall held good only for the examination held during or at the end of the academic year and nothing in this ordinance shall be deemed to debar the University from amending the Ordinance and the amended Ordinance, if any, shall apply to all students whether old or new.

19. Candidate admitted to M.Sc. Course in 1990-91 or earlier shall be governed by the old rules. The new rules shall be applicable w.e.f. the admission of academic Session 1991-92.

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ORDINANCE

ADMISSION OF PRIVATE CANDIDATES TO EXAMINATIONS

A private candidate shall mean a candidate who has not been on the rolls of Teaching Department of the M. D. University, Rohtak or a college admitted to the privileges of the M.D. University, Rohtak. Otherwise than as a casual student at any time during the academic year preceding the University Examination for which he is a candidate.

EXPLANATION

1. A casual student is one whose name is not on the rolls of the University Teaching Department/College as a regular student, but who, with the consent of the Principal/Head attends the College/Department for study of one or more subjects and pays the prescribed fees.

2. No one who has been on the rolls of a Teaching Department of the M.D. University, Rohtak or a College admitted to the privileges of the M.D. University, Rohtak otherwise than as a casual student any time during the Academic year preceding the University Examination shall be permitted to appear at that examination as a private candidate unless his admission the Examination as a private candidate is recommended by the Head of the University Teaching Department or the Principal of the College where he was studying. Provided he is eligible to appear in that examination under this Ordinance.

3. No one shall be eligible to appear as a private candidate in an examination, if he does not possess minimum qualifications and fulfil other requirements laid down in the ordinances for that examination, provided that the condition of minimum percentage of marks in time qualifying examination preseribed for the regular students shall not apply to private candidates.

4. Subject to Clause 2 & 3, the following categories of persons may be permitted to appear as private candidates in B.A.-II & III, B.Com., and M.A. (excluding the M.A. courses involving practicals or field work);

(a) A woman belonging to a place within the jurisdiction of this University;

(b) A person who has been residing within the jurisdiction of this University for at least two years continuously and has been for atleast one year prior to the date fixed by the University for the receipt of admission application forms of private candidate without late fee, a member of the whole time staff of any of the following:-

(i) The M.D. University or a college admitted to the privileges of this University;

(ii) A recognised School or a Public or Sainik School.

(iii) A technical School or a polytechnic recognised by Directorate of Technical Education, Haryana;

(iv) A Government/Semi-Government Department/Organisation or a Statutory Body set up by the Govt. of Haryana.

c) A person who has been residing at Chandigarh and/or within the jurisdiction of this University for two years continuously and has been in the service of Haryana Govt. or an Organisation or Statutory Body set up by the Haryana Govt. for not less than one year prior to the last date for submission of admission forms without late fee;

d) A member of a Scheduled Caste/Tribe who has been a resident of a place within the jurisdiction of this University for atleast two years on the last date for submission of admission forms without late fee;

e) A person belonging to a place within the jurisdiction of this University who has not more than three years prior to the year of examination either released by the appropriate authorities or has resigned from; i) Regular Land, Air, Naval Forces; ii) Territorial Army (Permanent Staff);

f) A person who belongs to a place within the jurisdiction of this University and has been in service of Central Government or High Court of Punjab and Haryana or Semi-Govt. Organisation/Statutory Body set up by the Central Government for not less than one year prior to the last date for submission of admission forms without late fee;

g) A person belonging to or residing at a place within the jurisdiction of this University and certified as permanent Handicapped by the Chief Medical Officer of concerned district or a Professor/Director of Pt. B.D. Sharma PGIMS Rohtak subject to permission by the Vice-Chancellor;

h) A person belonging to and serving a term of imprisonment in a jail within the territorial jurisdiction of this University provided a certificate of good conduct is given by the Superintendent of the Jail concerned and the term of imprisonment is likely to extend beyond the date of commencement of the examination.

i) An Advocate who, either belongs to or is practising Law at a place within the jurisdiction of this University.

j) A serving Defence personnel belonging to a place within the Jurisdiction of this University may appear in M.A. (Defence & Strategic Studies) examination in Private capacity.

5. A person who has been on the rolls of a College for B.A./B.Sc./B.Com. Course but has failed to secure the requisite percentage of marks on the combined results of the monthly tests and house examination may be allowed to appear the same year as an ex-student in the examination for the course for which he was enrolled provided (i) he has attended the prescribed percentage of lectures and practical:(ii)the Principal of the College concerned has no objection to his appearing in the examination.

6. A candidate who belongs to a place within the jurisdiction of this University and has already obtained Master's Degree may be permitted to appear in M.A. (excluding M.A. courses involving practicals or field work) examination in another subject as a private candidate.

7. Subject to fulfilling conditions prescribed for such examination, any person, belonging to the State of Haryana may be permitted to appear in B.A. Part-I, II, and III, examination under Ordinance relating to B.A. degree through English etc., and O.T./M.I.L., examinations as a private candidate.

8.(a) Where in the case of a subject prescribed for the B.A. Examination no arrangement for instruction exists in any college

admitted to the privileges of this University the Academic Council may permit a candidate to appear in the subject in the examination as a private candidate.

(b) A student of an Evening College may be permitted by the Vice-Chancellor to appear in an additional optional subject privately if arrangement for that subject do not exist in the college concerned.

9. A person who has qualified in one part of an examination and is transferred to a place outside the territorial jurisdiction of the University, may be allowed to complete the remaining parts(s) of the examination as a private candidate.

10. A person who has been permitted to appear as a private candidate in an examination but has failed in the examination may be admitted to such examination within the period as laid down for the ex-student in the ordinances for that examination.

11. A candidate who fails in an examination, or having been eligible fails to appear in an examination, shall take the examination as a private candidate, according to the syllabus prescribed by the University for regular student appearing for that examination, provided that the syllabus for the Supplementary Examination held in September/April shall be the same as was in force for the regular students in the last Annual Examination.

12. Notwithstanding anything contained in the ordinances for relevant examinations, a candidate who has passed his qualifying class in the supplementary exam. even in full subjects may be allowed to appear for higher course, if otherwise, eligible in the next annual exam., in the course/subject mentioned in Clause-4 in private capacity. If he fails to submit the proof of his having passed the qualifying exam. latest by December 31 of that year, his candidature for higher exam. shall stand cancelled.

SCHEME OF EXAMINATION
for
M.A./M.Sc.(Mathematics)

The duration of the course of instructions for M.A./M.Sc. (Mathematics) degree shall be two years. There will be five papers in each year course. The detailed Scheme of Examination for M.A./M.Sc. (Previous) Mathematics and M.A./M.Sc. (Final) Mathematics is as given below:-

M.A./M.Sc. (Mathematics) Previous 1996-97

			Max. Marks	Time
Paper-I	Real Analysis		100	3 Hours
Paper-II	Algebra		100	3 Hours
Paper-III	Mechanics and Calculus of Variations		100	3 Hours
Paper-IV	Differential and Integral Equations		100	3 Hours
Paper-V	Complex Analysis and Differential Geometry		100	3 Hours

M.A./M.Sc.(Mathematics) Final 1996-97

Paper-VI	General Topology		100	3 Hours
Paper-VII	General Measure Theory and Functional Analysis		100	3 Hours
Paper-VIII	Statistical and Numerical Methods and Computer Programming	Theory	70	3 Hours
		Practical	30	4 Hours
		(Computer Programming based on Statistical and Numerical Methods).		

Paper-IX & X Two papers to be offered out of either of the following groups :-

Applied Group :

A_1 Fluid Dynamics
A_2 Theory of Elasticity
A_3 Electro Magnetic Theory
A_4 Magnete Hydro-dynamics
A_5 Mathematical Statistics
A_6 Theory of Relativity
A_7 Mathematical Methods
A_8 Theoretical Seismology
A_9 Continuum Mechanics

Pure Group :

P_1	Theory of Numbers
P_2	Theory of Groups and Fields
P_3	Operator Theory
P_4	Applied Algebra
P_5	Computer Mathematics
P_6	Probability Theory
P_7	Differential Manifolds
P_8	Calculus on Banach Spaces
P_9	Approximation Theory
P_{10}	Fourior Analysis
P_{11}	Algebraic Topology and Category Theory.

Paper-VI **GENERAL TOPOLOGY**

Max. Marks : 100
Time : 3 Hours

Section-I (Three Questions)

Topological Spaces : Indescrete and descrete topological spaces. The notion of metric and metric spaces. Bounded and unbounded metric, open balls and open sets in metric spaces with their properties. Metric space as a topological space. Examples of Topological and metric spaces. Diameter of a subset of a metric space. Adherent point. Derived sets and their properties. Closed sets and closure. Kurtowaski closure axioms. Interior and exterior operators. Boundary of a set and boundary operator. Neighbourhood of a point in Topological space, its properties and topology determined by neighbourhood system. Base and sub-base. Relative topology and subspaces. Separation of sets. Connected sets components.

Section-II (Three Questions)

Complete metric spaces, Convergent sequences in metric spaces Cauchy's Principle of convergence in metric spaces. Cantor's inter-section theorem. Completion of a metric space. Compactness in topological spaces. Sequentially compact metric space. Heine Barel property and Bolzano weirstrass property in metric spaces. Totally boundeness in metric spaces and equivalance of sequentially compact and compactness in metric spaces. Compact sets in Topological Spaces. Finite Intersection property and compactness in terms of finite inter-section property. Countably compact and locally compact sets in Topological spaces. One point complification, Continuous function in Topological spaces, uniformly continuity in metric spaces. Properties of continous functions in Topological spaces as well as in metric spaces. Homeomorphism.

Section-III (Two questions):

First and second axiom of Countability. Linderoff space, separable spaces. Separation axioms, characterization of J_o,N_1,J_2 Js regular and normal spaces, J_3 and J_4 spaces, Urysohn's Jemma Tietze Extension Theorem Complete Regularity and Complete normality. T. 3 1/2 and T_5 spaces.

Section-IV (Two Questions)

Product Topological spaces. Projection mapping. Jickonov Topology Filters Ultra Filters. Jichonov Product Theorem. Stonecech compactification Theorem. Quotient spaces. Metrizability of Topological quotient space. Uryschan Metrizable Theorem.

Note : The question paper will contain ten questions as indicated. The candidate will be required to attempt five questions selecting at least one from each section.

Books Suggested :

1. Comron, E.T. Metric Spaces
2. Kelley, J.L. General Topology
3. Pervin, W.J. Foundation of General Topology.

Paper-VII FUNCTIONAL ANALYSIS & GENERAL MEASURE THEORY

Max. Marks : 100
Time : 3 Hours

Section-I (Two Questions)

Normed Linear spaces, Metric on normed linear spaces. Banach spaces. Quotient spaces. Examples of Banach spaces. Completeness of Tp and Lp spaces. Spaces of continuous functions. Bounded linear transformations. Equivalent formulation of continuity. Notion of topology comparison of Topologies. Homeomorphism. Metric space as a topological space. Isometry, Isometric Isomorphism and topological Isomorphism of normed linear spaces.

Section-II (Two Questions)

Equivalent norms. Finite dimensional normed linear spaces. Space of bounded linear transformations. Continuous linear functional conjugate spaces. General from of linear functionals in n dimensional. I_p, conjugate spaces of I_p. Riesz representation theorem for bounded linear functionals on L_p. Representation theorem for bounded linear functionals on a,b.

See Slip

Second conjugate space Canonical mapping theorem and its application to projections. Reflexive spaces. Open mapping theorem and its application to projections. Reflexive spaces. Closed graph theorem. Uniform bounded principle (Banach-Stein-hauss Theorem) and its application. Weak topologies. Weak Strong convergence.

Section-III (Three Questions)

Inner product and Hilbert spaces. Schwartz inequality Hilbert spaces as normed linear space. Examples convex sets in Hilbert spaces. Orthogonality, orthogonal complements, orthogonal sets. Bessel's inequality. Parseval's formula. The conjugate of a Hilbert space. Riesz representation theorem in Hilbert spaces. The adjoint of an operator. Self adjoint operators. Normal and Unitary operators. Projections.

Section-IV (Three Questions)

General Measure Theory : Measure spaces, Finite, σ finite and semi-finite measure. Measurable functions. Integration Fatous' lemma. Monotone convergence theorem. Lebesgue convergence theorem. General convergence theorem. Signed measures. Hahn decomposition theorem. Jordon decomposition theorem.

Radon-Nixodyn Theorem. Outer measure and measurability extension theorem. Caratheodary theorem. Lebesgue Stieltjes Integration. Product measure. Fubini Theorem. (Royden-Real Analysis : Chapters 3,4,5,11,12)

Note : The question paper will consists of ten questions as indicated. The candidate will be required to attempt five questions selecting at least one question from each section.

Books Suggested :

1. Bachman, G and Narici, I : Functional Analysis
2. Brown, A.L.and Page, A. : Elements of Functional Analysis
3. Halmos, P.R. : Measure Theory
4. Lusternik, I.A. and Soboleve, V.J. : Elements of Functional Analysis
5. Royden, H.L. : Real Analysis
6. Simmons, G.F. : Introduction to Topology and Modern Analysis.
7. Taylor, A.E. : Introduction to Functional Analysis

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Paper-VII Functional Analysis and General Measure Theory

Max.Marks : 100
Time : 3 Hours

Section-I(Two Questions)

Normed linear spaces. Metric on normed linear spaces. Banach spaces. Quotient spaces. Examples of Banach spaces. Completeness of L_p spaces. Spaces of continuous functions. Bounded linear transformation. Equivalent formulation of continuity. Notion of topology. Comparison of Topologies. Homoemorphism. Metric space as a topological space. Isometry, isometric isomorphism and topological isomorphism of normed linear space.

Section-II(Three Questions)

Equivalent norms. Finite dimensional normed linear spaces. Space of bounded linear transformations. Continuous linear functional conjugate spaces. Hahn Banach Theorem General form of linear functionals in n dimensional, l_p, conjugate spaces of l_p, Riesz representation theorem for bounded linear functionals on L_p. Representation theorem for bounded linear functionals on $C[0,1]$. Second conjugate space. Canonical mapping theorem and its application to projections. Reflexive spaces. Open mapping theorem and its application to projections. Closed graph theorem. Uniform bounded principle (Banach-Stein-hauss Theorem) and its application. Weak topologies. Weak and strong convergence.

Section-III(Three Q uestions)

Inner product and Hilbert spaces. Schwartz inequality Hilbert space as normed linear space. Examples of convex sets in Hilbert spaces. Orthogonality, orthogonal complements, orthogonal sets. Bessel's inequality. Parseval's formula. The conjugate of a Hilbert space. Riesz representation theorem in Hilbert spaces. The adjoint of an operator. Self adjoint operators. Normal and Unitary operators. Projections. Spectral Theorem on finite dimensional spaces.

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Contd.....P/2

Section-IV(Two Questions)

General Measure Theory: Measure spaces. Finite, σ-finite and semi-finite measure. Measurable functions. Integration, Factous lemma, Monotone convergence theorem. Lebseque convergence theorem. General convergence theorem. Signed measures. Hahn decomposition theorem. Jordon decomposition theorem. Radon-Nikodyn Theorem. Outer measure and Measurability extension theorem. Carathedary theorem, lebesque Stieltjes Integration. Product measure.

Fubini theorem.

(Royden-Real Analysis: Chapters 3,4,5,11,12).

Note: The question paper will consist of ten questions as indicated. The candidate will be required to attempt five questions selecting at least one question form each section.

Books Suggested

1. Bachman, G. and Narici, I. : Functional Analysis
2. Brown, A.L. and Page, A. : Elements of Functional Analysis
3. Halmos, P.R. : Measure Theory
4. Lusternik, I.A. and Soboleve V.J. : Elements of Functional Analysis
5. Royden, H.L. : Real Analysis
6. Simmons, G.F. : Introduction to Topology and Modern Analysis
7. Taylor, A.E. : Introduction to Functional Analysis.

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Paper-VIII STATISTICAL AND NUMERICAL METHODS AND COMPUTER PROGRAMMING

Max. Marks : 70

Time : 3 Hours

Section-I (Two Questions)

Difference Equations : Ordinary difference equations, Homogeneous difference equations, particular and general solutions of a difference equation, solution of linear difference equations with constant coefficients.

Ordinary Differential Equations : Numerical solutions of differential equations, Taylor's Euler, Picard and Runge-kutta methods. Milne's predictor-Corrector method, system of first order differential equations, numerov method, Boundary Value Problems, Eigen-Value Problems.

Partial Differential Equations : Solutions of Laplace and one dimensional heat equations. (Based on Chapter 7 of the book by Sastry).

Section-II (Two Questions)

Numerical Differentiation and Integration : Numerical differentiation, Numerical quadrature, Trapezoidal, Simpson's formula, Cote's formula Error estimation in Trapezodial and Simpson's formula, Bichardson extrapolation, Romberg integration.

Matrices : Matrix operations, Inversion of a matrix by Jorden Triangularisation, Choleski and Iterative methods. Solution of a system of linear equations by Gauss-elimination method and modification by Jorden, Gauss-Seldal method. Evaluation of Eigen values and Eigen vectors by Power and Jacobi methods.

Least Square Approximation : Principle of Least Squares and its applications to polynomial fittings. Five point formula for smoothing of data.

Section-III (Three Questions)

Statistical Methods : Random variables, Mathematical expectation, Moments and moment generating functions. Binomial, Negative Binormial, Poisson and Normal distributions. Regression, Correlation, Rank Correlation, Partial and Multiple Correlation.

Parameter, Statistic and sampling distributions. Sampling distribution of sample mean and coefficient of correlation for uncorrelated population. Large sample tests. The Chi-square, T and F distributions and test of significance based on them. Fisher's Z transformation.

Section-V (Three Questions)

Computer Programming in FORTRAN 77 : Preliminary concepts of algorithms and flow charts, constants and variables, representation for integers and real numbers, Arithmetic expressions, Input-output statements. If Statements, GOTO statements, CONTINUE statement Do Loop (simple and implied), Nested Do Loops. Arrays and subscripted variables: DIMENSION statement, arithematic expressions for subscripts.

Functions and subroutines : FUNCTION subprograms, Calling FUNCTION subprograms, SUBROUTINE VARIOUS FUNCTION.

Simple programmes for solving elementary problem.

Note : The question paper will consist of ten questions as indicated. The candidate will be required to attempt five questions selecting at least one question from each section.

Books Suggested :

1.	Froberg, C.E.	Introduction to Numerical Analysis.
2.	Sastry, S.S.	Introductory Methods of Numerical Analysis.
3.	Weatheburn, C.E.	A First Course in Mathematical Statistics.
4.	Hoel, P.G.	Introduction to Mathematical Statistics.
5.	Rajaraman, V.	Computer Programming in FORTRAN-77 (Prentice Hall, New Delhi).
6.	Lipschutz, S. and Poe, A	Theory and problems of programming with FORTRAN (Schaum's outline series, Mc-Graw Hill).

Paper-VII STATISTICAL AND NUMERICAL METHODS AND COMPUTER PROGRAMMING (PRACTICALS)

Max. Marks : 30
Time : 4 hrs.

Section-I (Two Questions)

Statistical Methods: Evaluation of Mean and Standard Deviation, Coefficient of Correlation. Rank Coefficient. Regression Lines, Binomial Distribution. t-test and Chi-square test

Section-II (Three Questions)

Numerical Methods : Derivative of a tabulated function, Integration by Trapezoidal Simpson's 1/3rd rule. Richardson Extrapolation, Gauss Elimination Method, Gauss-Seidal iteration Method, Eigen Values of

Third-order matrix, Taylor's Series Method, Euler's Method, Runge-Kutta Method, Milne's Predictor-Corrector Method, Simultaneous first Order Equations, Laplaces, equation by Iteration.

Note : Practicals will be of computer programming based on the above methods. The question paper will consist of five question as indicated. The candidates are required to attempt three questions in all, selecting at least one question from each section.

Paper-IX & X (Opt.A_1) FLUID DYNAMICS

Max Marks: 100
Time 3 Hours

Section-I(Two Questions)

Velocity at a point of a fluid, velocity potential strealines, pathlines and Streaklanes; Vort city and circulation, Vortexlines and Vortextubes; total and local rate of change, acceleration at a point of fluid in the vector form, deductions for the components of acceleration in cartestan, cylindrical and spherical coordinates, equation of continuity in the invariant form and its deduction for certesian, cylindrical and spherical coordinates Reynold's transport theorem rates of change of material integrals.

Pressure at a point in a moving fluid, Boundary conditions; Euler's equation of motion, Bernolli's equation; Kelvin's circulation theorem, Vorticity, equation, Energy equation for incompressible flow: (Relevant sections of Chapters 2 and 3 of the book "Ideal and Incompressible Fluid Dynamics).

Section-II (Three Questions):

Potential flow : Equations of motion and Boundary conditions, Acyclic and cyclic irritational motion, kinetic energy of irrotation flow, Kelvin's minimum energy theorem, mean value of the velocity potential, kinetic energy of infinite liquid uniqueness theorems.

Axially symmetric flows, Uniform flow, sphere at rest in a uniform flow, sphere in motion in fluid at rest at infinity, impulsive motion, kinetic energy generated by impulsive motion.

Sources, sinks and doublets; Hydrodynamical images for three-dimensional flows; images in a rigid infinite plane and spherical surfaces.

Two dimensional motion, kinetic energies of cyclic and acyclic irrotational motion, uniqueness of acyclic irrotational motion. Use of cylindrical polar coordinates.

Stream Functions: Langrange stream function for two dimensional flow; stream functions for uniform flow, source and doublets; stoke's stream

function for axissymmetric flow,; stokes streams functions for a uniform stream, simple source, doublet, uniform line a source and a doublet in a uniform strea.

(Relevant sections of chapter 4 and 5 of the book 'Ideal and Incompressible fluid Dynamic.)

Section-III (Two Questions)

Two Dimensional Flow: The complex potential, complex potentials for a uniform stream, source, doublet and vortex. Image system in plane flows; Milne-Thomson circle theorem, uniform flow past a fixed infinte circular cylinder, image of a line source in a circular cylinder, image of a line doublet parallel to the axis of a right circular cylinder, image of a cortex in a circle.

Blasius theorem, force on a circular cylinder in a uniform stream with circulation due to source and a doublet.

Vortex rows, an infinite row of line vertices, Karam vortex street.

(Relevant sections of Chapter 6 of the Book "Ideal and Incompressible Fluid Dynamics and chapter 5 of the Text book of Fluid dynamic.)

Section-IV (Three Questions)

Waves: Wave motion, gravity waves, particle paths, wave energy, group velocity, the effect of surface tension, standing waves, waves in a canal recoangular tank and cylindrical tank, waves on the surface of a uniform stream, waves at the interface between fluids, effect of surface tension on waves at the interface. (Chapter 8 of the book "Ideal and Incompressible fluid dynamics).

Viscours Flows: Stress analysis in fluid motion, relation between stress and rates of strain, Navier-stokes equations of a viscous fluid in vector form, special cases for Navier-Stokes equation in cylindrical and spherical coordinates.

Some solvable problems in viscous flow-steady flow between parallel planes, steady flow through tube of uniform circular cross-section, steady flow between concentric rotation cylinders.

Steady viscous flow in tubes of uniform cross-section-a uniqueness theorem, tube having uniform alliptic cross-section, tuble having equilateral triangular errors. Section.

Diffusion of vorticity, energy dissipation due to viscosity, steady flow past a fixed sphere (Section 8.6 to 8.14 of the book "Text book of fluid dynamics).

Note: The question paper will consist of ten questions as indicated. The candidates will be required to attempt five questions selecting at least one question from each section.

Books Suggested:

1. Michael, E.O.,Neill Ideal and incompressible fluid dynamic Ellis Horwood. Limited.

2. F. Chorlton Text book of Fluid Dynamics.

Paper-IX & X (Opt. A_2) THEORY OF ELASTICITY

Max Marks : 100

Time: 3 Hours

Section-I (Two Questions)

Cartesian Tensors: Transformation law of vectors, Contraction, Quotient Law, Substituion tensor. Alternating tensor.Eigenvectors and invariants of a real symmetric second order tensor.

Analysis of Strain: Infinitesimal affine deformation. Geometrical interpretation of components of strain. Strain quadric of Cauchy. Principal Strains. Examples of Strain. Equations of compatibility. Components of strain in cartesian, cylindrical and spherical coordinates.

Analysis of Stress: Stress vector and stress tensor. Equation of equilibrium. Symmetry of stress tensor. Stress quadirc of Cauchy. Principal stresses. Maximum normal and shear stresses. Mohr's diagram. Examples of stress. Equations of equilibrium in cartesian, cylindrical and spherical coordiantes.

Section-II (Two Questions)

Equations of Elasticity: Generalized Hooke's law. Hooke's law in media with one plane of symmetry, orthotropic and homogeneous isotropic media. Elastic moduli for isotropic media. Beletrami-Michell compatibility equations. Strain energy function. Clapeyron's theorem. Reciprocal theorem of Betti and Raylegh.

Two-Dimensional Elastostatic Problems: Plane strain and plane stress. Generalized plane stress. Airy's stress function. General solution of the biharmonic equation. Stress and displacement components in terms of two analytic functions. Thick walled tube under external and internal pressures. Rotating shaft. Rotating disk.

Section-III (Three Questions):

Extension and Bending of Beams: Extension of beams by longitudinal forces, beams stretched by its own weight, bending of beams by terminal couples, bending of a beam by a transverse load at the centroid of the end section along a principal axis, bending of circular and elliptic beams.

Torsion of Beams: Torsion of a circular shaft, torsion of cylindrical bars, stress function, torsion of elliptic, rectangular and equilateral triangular beams, circular groove in a circular shaft, Torsion of shafts of varying circular cross section.

Section-IV (Three Questions)

Elastic Waves: Simple harmonic progressive waves, scalar wave equation, special progressive type solution, plane waves, spherical waves, special stationary type solutions in Cartesian, cylindrical and spherical coordinates.

Wave propagation in unbounded elastic media, P, SV and SH waves of seismology, wave propagation in two dimensions, Rayleigh waves, love waves, reflection of P and SV waves at a free boundary. Reflection and refraction of SH waves at a solid-solid interface.

Radial vibrations of a solid elastic sphere and a spherial shell, radial vibrations of a solid elastic cylinder and a cylindrical shell.

Note: The question paper will consist of ten questions as indicated. The candidates will be required to attempt five questions selecting at least one question from each section.

Books Suggested:

1. Jeffreys, H. : Cartesian Tensors.
2. Sokolnikoff, I.S. : Mathematical Theory of Elasticity.
3. Bullen, K.E. and B.A. Bolt : An Introduction to the Theory of Seismology.
4. Coulson, C.A. : Waves.
5. Achenbach, J.D. : Wave Propagation in Elastic Solids.
6. Kolsky, H. : Stress Waves in Solids.

Paper IX & X (Opt. A_3) ELECTROMAGNETIC THEORY

Max Marks: 100

Time : 3 Hours

Section-I (Two Questions):

Electrostatic Field: Columb's law, electric intensity, electric potential, lines of force and equipotential surfaces, Gauss's theorem, theorems on the potential, electric dipole, equations of electrostatic field, two dimensional electrostatic field.

Conductors and Condensers: Mechanical force on a charged surface, a uniformed charged conducting sphere, concentric conducting spheres, cylindrical conductor, spherical and cylindrical condensers, condensers, formed of coaxial cylinders, energy of a charged conductor and condenser, condensers in series and in parallel.

System of Conductors: Principal of superposition, coefficients of capacity, induction and potential, Green's reciprocal theorem electrostatic energy of a system of conductors.

Section-II (Three Questions)

Dielectrics: Dielectric constant, displacement vector, conditions at the surface of discontinuity separating two media, refraction of lines of force, polarization vector, potential at a point inside a dielectric uniqueness theorem, Kelvin's minimum energy theorem.

Electric Images: Point charge placed in front of an infinite earthed conducting plane, point charge outside an earthed conducting sphere, finite sytem of images, infinite series of images, conducting sphere in a uniform electric field, applications of inversion.

Images in two dimensions, images of an infinite line charge in front of an infinite earthed conducting plane, line charge placed in front of an infinite earthed circular conducting cylinder.

Images in dielectrics, dielectric sphere placed in a uniform electric field.

Steady Electric Currents: Electromotive force, Ohm's law, kirchoff's laws for steady currents in linear conductors, Resistances in series and in parallel wheatstone bridge, general network, minimum rate of heat generation in a network.

Section-III (Three Questions)

Magnetism: Magnetic moment and field, magnetic potential magnetic lines of force and equipotential surfaces, Gauss's theorem, magnetic dipples, magnetic field of a dipole, potential energy of a dipole, mutual potential energy of two dipoles, force exerted by one dipole on another.

Intensity of magnetization, magnetic potential and force inside a magnetized body, boundary conditions at the surface of discontinuity.

Magnetic vector potential, magnetic boundary condition, magnetic shells, potential energy of a magnetized shell, magnetic energy of permanent magnets, energy of a system of megnetic shells.

Electromagnetism: Magnetic field of steady currents, amperes, circuital relation, magnetic vector potential for a steady current in a closed circuit, magnetic solar and vector potential due to current in an infinite streight wire potentials due to uniform current in an infinite long cylindrical

conductor, potentials due to a circular current loop, potential energy of a linear circuital current in a permanent magnetic field, potential energy of a current in its own field magnetic energy of a electric currents.

Section-IV (Two Questions)

Magnetic Induction and Induced Magnetism: Magnetic induction vector continuity of normal nduction, Induced magnetism, equations for the potential.

Law of electromagnetic induction, Len's Law self induction and mutual induction, single circuit with self induction, single circuit with a period electromotive force, plane circuit rotating uniformly in a uniform field of force, circuit containing a condenser.

Equations of Electromagentic field: Maxwell's displacement current, Maxwell's equations, Boundary conditions, electromagnetic potential poynting vector Radiation of energy, decay of free charge. Electromagnetic waves in an isotropic non-conducting media Electromagnetic waves.

Note: The question paper will contain ten questions as indicated. The candidates will be required to attempt five questions selecting at least one question from each section.

Books Suggested:

1.	Ferraro, V.C.A.	Electromagnetic Theory.
2.	Conlson,C.A. and Boyd, T.J.M.	Electricity.
3.	Jeans, S.O.	Mathematical Theory of Electricity Magnetism.
4.	Ramsey, A.S.	Electricity and magentism- An Introduction to the Mathematical Theory Cambridge University Press , London.

Paper IX & X (Opt. A_7) MATHEMATICAL METHODS

Max Marks : 100

Time 3 Hours

Section-I (Two Questions)

Integral Equations: Green's function solution of non-homogeneous ordinary differential equations:, self adjoint operators, construction of Green's function and its properties. Sturm-Liouville problem and orthogonal series expansion Fredholm integral equations and Green's

function. Homogeneous and non-homogeneous Fredholm equations with symmetric kernel, Hilbert-Schmidt theorem. (Secs. 4.1, 4.1.1., 4.1.2., 4.2., 5.2., 5.2.1., 5.2.2. of Jerri's book).

Section-II (Three Questions)

Special Functions: Transformation of Legendre equation to Bessel equation. Transformation of hypergeometric equations to Tschebyscheff, Jacobi and to the equation. Confluent hypergeometric equation and its transformation to Whittaker and Weber equation.

Hermite and laguerre polynomials, generating functions recurrence relations, Rodrigue's formula, orthogonal properties, expansion of simple functions in a series of Hermite, laguerre polynomials.

Haskel functions, spherical Bassel functions, legendre associated functions and differential equations, Recurrence relations for associated Legendre polynomials.

Section-III (Three Questions)

Integral Transforms: Mellin transforms, elementary properties, transforms of derivatives and integrals, inversion theorem, convolution theorem. Hankel transforms, elementary properties, inversion theorem, transforms of derivatives and elementary functions, relations between Fourier and Hankel Transforms.

Finite Fourier transforms, finite Fourier sine and cosine transforms, convolution theorems, applications of finite transforms. erf(x) erfc (x) Dirac delta function and its simple properties, unit step function.

Section-IV (Two Questions)

Variational Methods: Variational problem related to the biharmonic equation, Ritz method, Galerkin method, Kantorovich method Trefftz method, variational problems of torsion of beams, Rafalson method for the biharmonic equation, Least Square method collocation (Secs. 111, 112,113, 114, 115,116, 117, 118 119 120, 121,of Sokolonikoff's book).

Note: The question paper will contain Ten questions as indicated. The candidate will be required to attempt five questions selecting at least one question from each section.

Reference Books:

1. Jerri, A.J. — Introduction to Integral Equations with Applications.
2. Sokolnikoff.I.S. — Mathematical Theory of Elasticity.
3. Bath, M. — Mathematical aspects of Seismology.
4. Sneddon, I.N. — The use of Integral Transforms.
5. Sneddon, I.N. — Special functions of mathematics, Physics and Chemistry.

Paper IX & X (Opt. P_1) THEORY OF NUMBERS

Max Marks : 100
Time : 3 Hours

Section-I (Two Questions)

Primes in certain arithmatical progressions. Format Numbers and Mersenne numbers. Sieve of Eratisthenes. The function N (X). Farey series and Farey fractions. Some results concerning Farey series. Irrational numbers. Approximation of irrational numbers by rationals. Hurwitz's theorem irrationality of e and n.

Quadratic residues and non-residues. Legendre's symbol properties of quadratic residues and non-residues Gauss's Lemma and its applications. Quadratic Law of Reciprocity. Jacobi's Symbol Tests of Primality. General properties of congruences. Roots of Congruences. Residue of (P-1/2). Chinese Remainder Theorem. System of Linear congruences. Congruences to a prime power modulus.

Section-II (Three Questions) :

Finite continued fractions. Convergents to a continued fraction. Continued fractions with positive contants. The representation of rational and irrational numbers by simple continue fractions. The difference between the fraction and its convergents. Equivalent numbers. Periodic continued fractions. The series of Fibonocci and Lucas. Approximations to Irrational numbers. Best possible appromixations: purely periodic fractions. Pell's equation.

Section-III (Three Questions):

Diophantive equations. $x^2-y^2=z^2$ and $x^4+y^4=z^4$. The representation of number by two or four squares. Waring's problem Four square theorem. The numbers g(k) & G(k). Lower bounds for g(k) & G(k). Representation of real numbers by decimal. Termination and recurring decimals. Necessary and sufficient condition for a decimal to represent a rational number.

Algebraic number and integers: Gaussian integers and its properties. Primes and fundamental theorem in the ring of gaussian integers. Integers and fundamental theorem in Q (w) where $w^3 = 1$, algebric fields. Primitive polynomials. The general quadratic field Q(m), Units of Q(2). Fields in which fundamental theorem is false. Real and complex Euclidean fields. Fermat's theorem in the ring of Gaussian integers. Primes of Q(2) and Q(5). Luca's test for the primality of the mersenne number. Ideals in a quadratic field. Other fields Q(2+i), Q(2+3) and

Section-IV (Two Questions):

Arithmatical function O(n),(n),d(n)and o(n) Mobius inversion formulae. Perfect numbers. Order and average order of d(n), O(n). The functions O(x),(x) and x)(for dx-2. Betrand postulate. Sum P^{-1} and product $1+p^{-1}$.Merten's theorem Selberg's theorem. Prime number Theorem.

Books Suggested :

1.	Artin, E.	Theory of Algebraic Numbers.
2.	Hardy, G.H. and Wright, E.M.	An introduction to the Theory of Numbers.
3.	Nagell,T.	Introduction to Number Theory
4.	Burton, D.M.	Elementary Number Theory
5.	McCoy N.H.	The Theory of Number by Mc. Millan.
6.	Niven, I and Zuckermann, H.S.	An Introduction to the Theory of Numbers.
7.	Weyl.	Algebraic Theory of Numbers.

Paper IX & X (Opt.P_2): THEORY OF GROUPS AND FIELDS

Max. Marks : 100
Time : 3 Hours

Section-I (Three Questions):

Normalizer, Centralizer, Center, Class equation of finite groups, Sylows Theorem, Servey of groups upto order 15, Commutators and three subgroup Lemma of P. Hall.

Section-II (Three Questions)

Central series, Lower and upper central series. Nil potent groups. Solvable groups, Free abolian groups, structure theory of finite finitely generated abolian groups, divisible abelian groups free group and the subgroup theorem.

Section-III (Two Questions)

Prime fields, simple extensions, algebraic and transcendental extensions, finite extensions, separable extensions and splitting fields normal extensions.

Section-IV (Two Questions):

Galois fields, Galois theory and its application to solvability by radicals of the equations of degree 4 over a field of characteristic zero. Constructions with ruler and Compass.

Note : The question paper will consist of ten question as indicated. The candidate will be required to attempt five questions selecting at least one question from each section.

Books Suggested :

1.	Hall, M.	Theory of Groups
2.	Scott, W.R.	Group Theory
3.	Macdonald, I.D.	The Theory of Groups
4.	Kurosh, A.G.	Theory of Groups, Vol. I and Vol. II
5.	Kaplansky, I.	Infinite Abelian Groups
6.	Herstein, I.N.	Topics in Algebra, Vol. I.
7.	B.L. Vander Warden	Modern Algebra, Vol. I.
8.	Jacobson, N.	Lectures in abstract Algebra, Vol. II
9.	T.I.F.R.	Mathematical Pamphlet No. 3 Galois Theory.

Paper IX & X (Op P_4) **APPLIED ALGEBRA**

Max. Marks : 100

Time : 3 Hours

Section-I (Two Questions):

Linear cods. Description of Linear Codes by Matrices, Coset Decomposition of Linear codes, linear code equivalence, Dual code, Weight distributions and Mac Williams identities.

Section-II (Three Questions)

Construction, of finite fields, minimal polynomials, cyclic codes, factors of x^n-1, BCH Codes, Hamming codes, Maximum distance separable Codes (MDS), Generator and Parity check matrice of MDS Codes, Bounds on minimum distance for linear codes, Hadamard matrics and Hadamard Codes.

Section-III (Two Questions):

Linear groups, Maschke's Theorem Schur's Lemma, Representations and Characters. (12.1.1 to 12.1.6 and 12.2.1 to 12.2.24 of Chapter 12, Group Theory by W.R.Scott).

Section-IV (Three Questions):

The p^iq^j theorem, Representations of Direct sums, Induced representations, Frobentius groups, Representations of transitive groups. Representation and Characters of some groups of small orders, Monomial

representations. Th. 12.3.1-12.3.3, 12.4 (complete) 12.5.1-12.5.11, 12.6.1-12.6.2, 12.6.6,2.6.18,12.6.19, 12.6.22, 12.7 (Complete) 12.8.1.12.8.2,12.8.4.

Note : The question paper will consist of ten questions as indicated. The candidate will be required to attempt five questions selecting at least one question from each section.

Books Suggested

1.	G. Birkhoff and T.C. Bartee	Modern Applied Algebra. McGraw Hill Inc., 1970.
2.	L.L. Dornhoff and F.E. Hohn	Applied Modern Algebra, Mac Millan, Co. Inc. 1978.
3.	F.J. Mac Williams and N.J.A. Slonae	The Theory of Error-Correcting Codes North Holland Pb. Co. Amstedum, New York, Oxford, 1978.
4.	J.H. Van Lint	Coding Theory, springer-Verlag Lecture Notes in Mathematics No. 201,1971.
5.	W.R.Scott	Group Theory, Prentice Hall Inc. 1964.
6.	G.G. Hall	Applied Group Theory.
7.	S.Lang	Algebra Addision-Wesley, 1977.

Paper IX & X (Opt.P_8) **CALCULUS IN BANACH SPACES**

Max. Marks : 100

Time : 3 Hrs.

Section-I (Two Questions):

The notion of norm on vector spaces. Normed Linear Spaces, Normed linear spaces as metric spaces. Convergence of series in normed linear spaces. Banach spaces, absolutely convergent series. Subspaces and finite product of normed spaces condition of continuity of multilinear mappings. Equivalent norms. Spaces of continuous multilinear mappings.

Section-II (Two Questions):

Closed Hyper planes and continuous linear functions. Finite dimensional normed spaces. Separable normed spaces. Spaces of bounded functions. Spaces of bounded continuous functions. Equicontinuous sets. Regulated functions.

Section-III (Three Questions):

Derivative of a continuous mapping in Banach spaces. Formal rules of derivatives. Derivatives in spaces of continuous linear functions. Derivatives of function of one variable. The mean value theorem. Application of mean value theorem.

Section-IV (Two Questions):

Primitive and Integrals: Partial derivatives. Jacobians. Derivative of an integral depending on a parameter. Higher derivative. Differential operations. Taylor formula.

Note : The question paper will consist of ten questions as indicated. The candidate will be required to attempt five questions selecting at least one question from each section.

Books Recommended :

1. Dieudonne J. Foundations of Modern Analysis
2. Carton, H. Differential Calculus.